5.1 Luxembourg (LU)

5.1.1 Main messages from the Commission assessment of the NPF

In its original assessment of the Luxembourgish NPF, the Commission concluded:

The Luxembourgish NPF broadly addresses the requirements of Article 3. It contains tables of the current state and future estimates for alternative fuels vehicles in the transport sector. For most fuels and modes, it establishes targets as required by Article 3 of the Directive. It does not provide a target for its inland port in the TEN-T Core Network.

The Luxembourgish NPF puts the accent on electric vehicles deployment with ambitious plans in terms of recharging infrastructure and share of electric vehicles on the road in 2020 (more than 9% from the total vehicle fleet). Bicycles and electric bikes also receive support. To be highlighted is the fact that Luxembourg has legislated a very detailed action plan for the implementation of the public recharging infrastructure for electric vehicles (including the exact number of recharging points per commune and TEN-T Core Network segments). The NPF foresees a small increase of available ground power units for stationary airplanes. The Mertert inland port does not have shore-side electricity and no targets are foreseen in the NPF.

While the spatial distribution of recharging points seems to cover appropriately the needs of electric vehicles in terms of distance requirements in Luxembourg, the ratio of more than 22 electric vehicles per one recharging point for 2020 could evolve to become a barrier for the further market deployment of electric vehicles. This could also lead to market fragmentation within the EU. It will be important to closely monitor this development and correct the infrastructure targets in line with the market developments.

In the case of CNG, the Luxembourgish government is pessimistic regarding the economic viability for this fuel. Therefore, it plans the decrease of the number of refuelling points to two CNG refuelling points considering this quantity to be sufficient in the medium term, estimating also a reduction of the CNG fleet.

Concerning LNG, the installation of a refuelling infrastructure for road transport is envisaged for 2020. Such an infrastructure will be intended to refuel apart from the LNG vehicles registered in Luxembourg the heavy-duty vehicles transiting the country. LNG-powered vessels having a high autonomy, an LNG refuelling infrastructure in the port of Mertert is not deemed as viable.

For the moment, the Luxembourgish government decided not to include in the current stage refuelling points for hydrogen accessible to the public in its NPF.

The Luxembourgish NPF contains a comprehensive list of measures, most already in place. According to the assessment methodology, a High overall assessment score is derived for electricity for vehicles, a Medium overall score for hydrogen for vehicles and a Low overall score for CNG for vehicles. This is a consequence of the government estimation that CNG will only play a marginal part in the future, the focus being placed on the promotion of electric mobility which is considered to be the most suited for the decarbonisation of the transport sector in the NPF.

Two regulations (one Grand Ducal and another Ministerial) provide evidence that the interests of local authorities and stakeholders have been considered. Luxembourg is actively involved in

coordinating its plans on alternative fuels infrastructure with the Benelux countries and has signed a collaboration agreement with them in this field. It may be advisable to extend this cooperation effort also towards other neighbouring countries such as France and Germany.

5.1.2 Overview of requirements' fulfilment from Annex I of the Directive

Table 5.1.2-1 Checklist Table

Part of the Directive 2014/94/EU	Mode of T Alterna (provided	ransport / tive Fuel in the NIR)	Yes / No	
ANNEX I: 1. Legal measures	Information on legal measures, which may consist of legislative, regulatory or administrative measures to support the build-up of alternative fuels infrastructure, such as building permits, parking lot permits, certification of the environmental performance of businesses and fuel stations concessions.	Road / elec hyd	ctricity, CNG, rogen	Y
ANNEX I: 2. Policy measures supporting the implementation of the national policy frameworkInformation on those measures shall include the following elements: • direct incentives for the purchase of means of transport using alternative fuels or for building the infrastructure, • availability of tax incentives to promote means of transport using alternative fuels and the relevant infrastructure, • use of public procurement in support of alternative fuels, including joint procurement, • demand-side non-financial incentives, for example preferential access to restricted areas, parking policy and dedicated lanes, • technical and administrative procedures and legislation with regard to the authorisation process.• consideration of the need for renewable jet fuel refuelling points in airports within the TEN-T Core Network			ctricity, CNG, rogen	Y
	 consideration of the need for renewable jet fuel refuelling points in airports within the TEN-T Core Network 			N
ANNEX I: 3. Deployment and manufacturing support	• Annual public budget allocated for alternative fuels infrastructure deployment, broken down by alternative fuel and by transport mode (road, rail, water and air).	Road / ele	Y	
	• Annual public budget allocated to support manufacturing plants for alternative fuels technologies, broken down by alternative fuel and by transport mode.	Road / ele scoote	ectricity (for ers only)	Y
	 Consideration of any particular needs during the initial phase of the deployment of alternative fuels infrastructures. 			N
ANNEX I: 4. Research, technological development and demonstration	 Annual public budget allocated to support alternative fuels RTD&D, broken down by fuel and by transport mode. 	Road, combination / electricity, AF (in general)		Y
ANNEX I: 5. Targets and objectives	 Estimation of the number of alternative fuel vehicles expected by 2020, 2025 and 2030 	Road, water / electricit	borne (inland) y, CNG, LNG	Y
	• Level of achievement of the national objectives for the deployment of alternative fuels in the different transport modes (road, rail, water and air)	Road, water / electricit LPG, e	Y	
	 Level of achievement of the national targets, year by year, for the deployment of alternative fuels infrastructure in the different transport modes 	Road, water air / electric L	borne (inland), ity, CNG, LNG, PG	Y
	 Information on the methodology applied to take account of the charging efficiency of high power recharging points 	All	Electricity	N
ANNEX I:6 Alternative fuels infrastructure developments			N	

The checklist shows the requirements of Annex I from the Directive that are covered in the LU NIR.

Regarding the combination of AF/AFV/AFI with transport mode, electricity is fully covered for road and, to a lesser extent, for waterborne (inland) and air; CNG and LNG are covered for road; some other combinations are just mentioned (for example: hydrogen, LPG and biofuels for road, LNG for waterborne inland transport). All the other combinations are either absent or not applicable.

The LU NIR reports 29 measures. Under the Policy and Deployment & Manufacturing sections it was possible to identify three AF/transport mode clusters of measures, all assessable.

5.1.3 Quantitative assessment: Vehicles and infrastructure

Table 5.1.3-1 National AFV estimates and AFI targets established in the NIR at the horizon 2020, 2025 and 2030 and their comparison with the NPF situation

		201	8	2020		20	25	2030		
Alternative fuel / Transport mode		AFV	AFI public	AFV	AFI public	AFV	AFI public	AFV	AFI public	
	NIR	3,373	841	10,465	1,635	101,300	5,160	202,600	10,320	
Electricity / road	Change NIR vs NPF [%]			-73.84%	-7.00%	130.23%	163.00%	322.08%	375.58%	
	Attainment [%]			32.23%	51.44%	3.33%	16.30%	1.66%	8.15%	
CNG / road	NIR	314	2	180	2	125	1	100	1	
	Change NIR vs NPF [%]			-10.00%	100.00%	25.00%	0.00%	0.00%		
	Attainment [%]									
	NIR	13	0	50	0	150	0	150	0	
LNG / road	Change NIR vs NPF [%]			66.67%	-100.00%		-100.00%			
	Attainment [%]			26.00%		8.67%		8.67%		
LNG / water (inland)	NIR	1	0	1	0	1	0	1	0	
	Change NIR vs NPF [%]									
	Attainment [%]			100.00%		100.00%		100.00%		
	NIR		5		6		10		10	
Shore-side electricity supply /	Change NIR vs NPF [%]									
water (inland)	Attainment [%]				83.33%		50.00%		50.00%	
	NIR		44		44		44		44	
Electricity supply / air (stationary	Change NIR vs NPF [%]				57.14%					
airplanes)	Attainment [%]				100.00%		100.00%		100.00%	
	NIR	NA	NA	NA	NA	NA	1	NA	1	
H2 / road	Change NIR vs NPF [%]									
	Attainment [%]									
	NIR	377	14	NA	NA	NA	NA	NA	NA	
LPG / road	Change NIR vs NPF [%]									
	Attainment [%]									
	NIR	56	NA	NA	NA	NA	NA	NA	NA	
Ethanol / road	Change NIR vs NPF [%]									
	Attainment [%]									
	not appl	icable								

Legend:

NA

the value could not be computed

no value/information provided/available in the NIR

5.1.3.1 Road transport

5.1.3.1.1 Electricity

Vehicles

Luxembourg reported for 2018 a total number of 3,373 electric vehicles in use (Table 5.1.3-1). These electric vehicles were divided in 3,118 passenger cars (1,360 battery-electric and 1,758 plug-in hybrid electric), 192 light commercial vehicles LCVs (all battery-electric), 8 heavy commercial vehicles HCV (all battery-electric), and 55 buses and coaches (33 battery-electric and 22 plug-in hybrid electric).

Regarding the vehicle estimates for the next decade, the LU NPF had presented a scenario with a ramping up of electric passenger cars from less than 1,000 in 2016 to 40,000 in 2020, followed by a moderate increase to 44,000 and 48,000 in 2025 and 2030 respectively. The LU NIR presents a new plan with a much higher ambition: whilst the estimate is lower in 2020 with 10,465 vehicles (74% less), it is by far more than compensated by the increase to 101,300 and 202,600 vehicles in 2025 and 2030 respectively (130% and 322% more). The vast majority of the electric vehicles in 2030 will be passenger cars (200,000), but 1,000 battery-electric LCVs, 100 battery-electric HCVs, 1,400 battery-electric buses and coaches and 100 plug-in hybrid electric buses and coaches are also foreseen. Furthermore, the LU NIR provides information regarding electric powered two wheelers (PTW). From the 488 PTWs registered in 2018, future estimates in the NIR go up to 1,000, 2,500 and 5,000 for the years 2020, 2025 and 2030 respectively.

The 2018 *attainment* of future EV estimates is 32.23% for 2020 and 1.66% for 2030. According to the assessment methodology described in Section 2.1, the 2018 situation corresponds to an *adequate progress* towards reaching the envisaged EV estimates. The calculated *average annual growth rate* corresponding to the period 2016-2030 for EV fleet evolution planned by Luxembourg is equal to 46%.

Infrastructure

Luxembourg recorded 841 publicly accessible recharging points in 2018 (Table 5.1.3-1), four times more than in 2016. The NIR targets for 2020/2025/2030 are 1,635/5,160/10,320 recharging points, of which 35/160/320 are high power (>22kW) recharging points. Compared to the NPF, the LU NIR now targets a slightly lower (-7%) number of recharging points in 2020, but much higher numbers for the years 2025 (+163%) and 2030 (+375%). These higher recharging infrastructure targets confirm the government's plan to become "… *one of the main players in electric mobility*" and the importance of road vehicle electrification in the Luxembourgish AFI development.

The 2018 *attainment* of future publicly accessible recharging infrastructure targets is 51.44% for 2020 and 8.15% for 2030. According to the assessment methodology described in Section 2.1, the 2018 situation corresponds to an *adequate progress* towards reaching these envisaged targets. The calculated *average annual growth rate* corresponding to the period 2016-2030 for publicly accessible recharging infrastructure evolution planned by Luxembourg is equal to 31%.

Ratio

Based on the LU NIR, the following table shows the ratio between vehicles and publicly accessible recharging points (i.e. sufficiency index) for the pair electricity/road. It can be seen that whilst until 2020 each publicly accessible charging point serves around five electric vehicles, the longer-term vehicle estimates and infrastructure targets foresee that one charging point needs to serve 20 vehicles from 2025 onwards. The LU NIR explains that the number is considered sufficient, based on a study conducted in 2011 showing that 95% of charging will be done at private charging points. However, considering the large distance to target already observed in the NPF and the very low share of high power charging points (3%) in the whole period, the future adequacy of recharging infrastructure for electric vehicles remains uncertain.

Luxembourg announced in the NIR that an inventory of private charging points should be available for the next report.

Sufficiency Index		2016	2017	2018	2020	2025	2030
Road	Electricity	5.27	6.76	4.01	6.40	19.63	19.63

Information on charging efficiency

Information is not available in the Luxembourgish NIR

5.1.3.1.2 CNG

Vehicles

The CNG fleet in Luxembourg counted a total of 314 vehicles in 2018 (Table 5.1.3-1), of which 195 passenger cars, 56 LCVs, 11 HCVs and 52 coaches and buses. According to the LU NIR, which broadly confirms the NPF estimates, CNG vehicle numbers in most categories will decrease to a total of 100 vehicles in 2030, with the exception of buses and coaches increasing slightly to 65 in 2030.

Because the Luxembourgish NIR provided decreasing estimates for CNG vehicles, the 2018 *attainment* and *progress* have not been computed.

Infrastructure

The Luxembourgish NIR indicates that 2 publicly accessible (and 1 private) CNG refuelling points were available in 2018. These numbers should be stable until 2020, after which only one public and one private CNG refuelling points should remain until 2030.

Because the Luxembourgish NIR provided decreasing targets for publicly accessible CNG refuelling infrastructure, the 2018 *attainment* and *progress* have not been computed.

Ratio

Based on the LU NIR, the following table shows the ratio between vehicles and publicly accessible refuelling points (i.e. sufficiency index) for the pair CNG/road. It can be seen that the sufficiency index is always well below the indicative value of 600 (see Section 2.1.5) for the whole 2016-2030 period.

Sufficiency Index		2016	2017	2018	2020	2025	2030
Road	CNG	49.00	53.67	157.00	90.00	125.00	100.00

5.1.3.1.3 LNG

Vehicles

Luxembourg recorded 13 LNG vehicles in total in 2018 (Table 5.1.3-1), consisting of HCVs exclusively. Concerning the estimates for the next decade, while the NPF had foreseen only an increase to 30 vehicles in 2020, the LU NIR now indicates 50 HDVs in 2020, and 150 HCVs from 2025 until 2030.

The 2018 *attainment* of future LNG vehicles estimates is 26% for 2020 and 8.67% for 2030. According to the assessment methodology described in Section 2.1, the *progress* obtained by Luxembourg from 2016 until 2018 for LNG vehicles deployment is 8.05% of the overall planned deployment during the period 2016-2030.

Infrastructure

Luxembourg did not record any publicly accessible LNG refuelling point in 2018. The LU NIR does not plan to have any publicly accessible LNG refuelling point until 2030, in contrast to the NPF where a target of one was present for 2020 and 2025. The LU NIR indicates that only one private LNG refuelling point was in use in 2018 and will continue until 2030.

Since at the end of 2018 there were no publicly accessible LNG road refuelling points deployed, the 2018 *attainment* and *progress* could not be computed.

Ratio

For the same reason, it is not possible to compute the sufficiency index.

5.1.3.1.4 Hydrogen

Vehicles

At this moment, hydrogen is not considered in the Luxembourg fuel mix, therefore no information was provided in the Luxembourgish NIR.

Infrastructure

There was no hydrogen infrastructure registered in 2018 and no plan for the future, however the LU NIR declares that "the government has committed, in its coalition agreement 2018-

2023 (¹), to arrange for at least one hydrogen refuelling station to be installed at one of the motorway service areas". This could take place by 2025.

5.1.3.1.5 Biofuels

Vehicles

The bioethanol vehicle fleet in Luxembourg consisted of 56 vehicles in 2018, not differing much from the numbers in previous years (57 and 61 in 2016 and 2017, respectively). This fleet is made up of passenger cars, with the exception of one LCV, operational since 2017. There are no estimates for the next decade in the LU NIR. For this reason, the 2018 *attainment* and *progress* could not be computed.

Infrastructure

Information is not available in the Luxembourgish NIR.

Ratio

Because of the lack of data, the sufficiency index could not be computed.

5.1.3.1.6 LPG

Vehicles

Luxembourg registered 377 LPG vehicles in 2018, of which 271 were passenger cars. Another 98 LCVs and 8 HCVs completed the LPG fleet. No estimates for the LPG fleet development in the years 2020-2030 are made in the LU NIR. For this reason, the 2018 *attainment* and *progress* could not be computed.

Infrastructure

According to the information provided by Luxembourg with the NIR, 14 public LPG refuelling points were operational in Luxembourg in 2018. No predictions for the development of the LPG refuelling points in the years 2020-2030 are made in the LU NIR. For this reason, the 2018 *attainment* and *progress* could not be computed.

Ratio

Based on the LU NIR, the following table shows the ratio between vehicles and publicly accessible refuelling points (i.e. sufficiency index) for the pair LPG/road for the years 2016-2018.

Sufficiency Index		2016	2017	2018	2020	2025	2030
Road	LPG	25.79	27.64	26.93			

¹ <u>https://gouvernement.lu/dam-assets/documents/actualites/2018/12-decembre/Accord-de-coalition-2018-2023.pdf</u>, Coalition agreement 2018-2013, Luxembourg Government, December 2018.

5.1.3.2 Rail transport

Information is not available in the Luxembourgish NIR.

5.1.3.3 Waterborne transport (maritime)

Not applicable since Luxembourg has no maritime ports in the TEN-T Core Network.

5.1.3.4 Waterborne transport (inland)

5.1.3.4.1 Electricity

Vessels

The LU NIR counts one electric inland waterway vessel since 2016. This number remains constant for the period up to 2030.

Infrastructure

Luxembourg recorded five shore-side electricity supplies in 2018 and presents a target of six in 2020 and of 10 from 2025 to 2030.

The 2018 *attainment* of future targets for shore-side electricity supply points in inland ports is 83.33% for 2020 and 50% for 2030. According to the assessment methodology described in Section 2.1, the *progress* obtained by Luxembourg from 2016 until 2018 for the deployment of shore-side electricity supply points in inland ports is 50% of the overall planned deployment during the period 2016-2030.

5.1.3.4.2 LNG

Vessels

The LU NIR lists one LNG powered vessel in 2018 expected to remain in service for the next decade.

Infrastructure

The Luxembourgish NIR confirms the NPF strategy that no LNG refuelling facilities for inland waterway navigation are foreseen until 2030.

5.1.3.5 Air transport

5.1.3.5.1 Electricity

Airplanes

Information on electric airplanes is not available in the LU NIR.

Infrastructure (for stationary airplanes)

The currently existing 44 electricity supply points for stationary aircraft at the TEN-T Core Luxembourg airport are considered sufficient and remain, according to the NIR, constant over

coming years. The LU NIR mentions as well that 28 of the electricity supply points consist of Ground Power Units (GPUs) (diesel engines coupled to generators).

5.1.3.5.2 Biofuels

Airplanes

Information is unavailable in the Luxembourgish NIR.

Infrastructure

Information is unavailable in the Luxembourgish NIR.

5.1.4 Measures assessment

The Luxembourgish NIR presents an extended portfolio of measures compared to the NPF. However, the overall strategy remains the same, with almost total focus on the combination electricity/road (targeting both AFI and AFV), and only some generic reference to other AFs/transport modes.

5.1.4.1 Legal measures

The Luxembourgish NIR contains 12 legal measures, including five new measures compared to the NPF. These measures represent a step forward to create a legally solid background to support the realisation of the AFV/AFI objectives as described in the NPF and revised in the NIR. The level of ambition of the legal measures has increased in the NIR, compared to the NPF.

5.1.4.1.1 Legislative & Regulatory

All legal measures described in the Luxembourgish NIR fall under legislative and regulatory measures, and most of them target road transport and electrification (addressing AFV and both public and private AFI). One legal measure introduced the obligation of owning a "zero-emission taxi" (i.e. BEV or fuel cell vehicles) in order to be eligible for any future operating licence. Ten measures were already in place in 2019. The remaining two have been adopted, and present an update or extension of two other measures. The first is the Grand-Ducal Regulation of 20 December 2019, amending the Grand-Ducal Regulation of 7 March 2019 and introducing financial aid for the promotion of zero or low CO₂ emission road vehicles. The second is the Grand-Ducal Regulation of 20 December 2016 and implementing Article 104(3) of the amended Income Tax Law of 4 December 1967. The first measure addresses electric vehicles (both BEV and PHEV) and hydrogen vehicles. The second one targets all company cars with an internal combustion engine and the application of the WLTP test cycle for the type-approval of vehicles.

5.1.4.1.2 Administrative

No administrative measures are reported in the NIR of Luxembourg.

5.1.4.2 Policy measures

The Luxembourgish NIR contains eight policy measures, which were all in place in 2019, and are different from the policy measures identified in the NPF. All measures focus on road transport. Seven policy measures target electricity as fuel, two of them in combination with hydrogen. One measure is related to CNG buses and infrastructure for public transport.

5.1.4.2.1 Measures to ensure national targets and objectives

Of all the policy measures described in the Luxembourgish NIR, four are categorised as measures to ensure national targets and objectives. The measures focus on road/electricity, with hydrogen included in two of them. These are:

- A tax allowance scheme, which was initially allowed only for BEV, fuel cell vehicles and bicycles with electric pedal assistance. This measure was later extended also to PHEV emitting less than 50 gCO₂/km and was integrated with a revision of the benefit in kind, calculated on the basis of CO₂ emission, with a further penalty for diesel vehicles.
- The obligation for government services to buy only BEV or, where appropriate, PHEV from 2018. Ordinary administrative-type cars with internal combustion engines (petrol or diesel) can only be purchased in exceptional circumstances, and with the necessary authorisation.
- An information campaign to raise public awareness regarding sustainable mobility and to inform municipalities, employers and citizens about the measures and incentives in place to support the uptake of alternative fuels solutions for mobility.
- Financial incentives for the purchase of BEV and fuel cell vehicles (€5,000), PHEV emitting less than 50 gCO₂/km (€2,500) and up to €500 for battery-electric quadricycles, motorcycles and mopeds.

5.1.4.2.2 Measures that can promote AFI in public transport services

Four policy measures can be categorised as measures that can promote AFI in public transport services. They deal with the deployment of alternative fuel buses and related infrastructure by four public transport operators in Luxembourg, three focussing on BEV and PHEV buses and one on CNG buses.

5.1.4.2.3 Measures that can promote the deployment of private electro-mobility infrastructure

Concerning the measures that can promote the deployment of private electro-mobility infrastructure, the LU NIR mentions one measure in the Policy section, which is also included in the list of the Legal measures. It establishes obligations to install recharging point in private buildings and provide requirements to do so, however it does not report quantitative information that would allow an assessment.

5.1.4.3 Deployment and manufacturing support

The Luxembourgish NIR contains three measures in place during the implementation period to support AFI deployment and manufacturing. All were different to the one measure identified in the NPF.

5.1.4.3.1 AFI deployment

The Luxembourgish NIR reports two AFI deployment measures. One relates to the deployment of 1,600 charging points for electric vehicles by end 2020, coming with a budget of 10 million \in . The second one is the modernisation of two CNG refuelling points, finished in 2018 with a budget of \notin 100,000.

5.1.4.3.2 Support of manufacturing plants for AF technologies

The Luxembourgish NIR lists one measure to support a manufacturing plant for electric scooters. State funding in 2017 amounted to about €70,000.

5.1.4.3.3 Consideration of any particular needs during the initial phase of the deployment of alternative fuels infrastructures

Information is not available in the Luxembourgish NIR.

5.1.4.4 Quantitative assessment of Policy and Deployment & Manufacturing measures

Table 5.1.4-1 presents an analysis of all the Policy and Deployment & Manufacturing measures, carried out according to the assessment methodology described in Section 2.2. As it can be seen, three clusters could be identified in the LU NIR. The electricity/road cluster is the only having a high score and being comprehensive; the clusters for the pairs CNG/road and hydrogen/road receive a medium score and are not comprehensive. No measure was mentioned in the LU NIR related to LNG. In terms of expected impact of these measures to support the realisation of the AFV/AFI objectives as presented in the NPF and revised in the NIR, the measures for the pair electricity/road result to have a high impact, those for the pairs CNG/road and hydrogen/road have a low impact.

Compared to the NPF, the level of ambition of the Policy and Deployment & Manufacturing support measures has increased for all three clusters.

AF	Transport mode	Score	Comprehensiveness	Impact		Ambition (NIR vs NPF)
Electricity	Road	Н	С	н		+
CNG	Road	М	Ν	L		+
	Road					
LNG	Water - inland					
H2	Road	M	N	L		+

Table 5.1.4-1 Quantitative assessment of Policy and Deployment & Manufacturing support measures

Legend: Score and Impact: H = high; M = medium; L = low; X = not assessable. Comprehensiveness: C = comprehensive; N = Not comprehensive. Ambition level: '+' means 'higher'; '=' means 'comparable'; '-' means 'lower'.

5.1.4.5 Research, Technological Development & Demonstration

The Luxembourgish NIR lists four RTD&D projects. The projects are new and differ from those presented in the NPF. For this reason, it is not possible to provide a comparison in terms of ambition between the NIR and the NPF. The MERLIN (²) project, which is funded by the European Regional Development Fund (ERDF), aims to develop a platform for assessing the impact of the country's various mobility solutions. The eCoBus (³) project, funded by the Luxembourg National Research Fund (FNR), aims to develop a cooperative and integrated intelligent transport system (ITS), which will coordinate electric buses, recharging infrastructure and traffic management. The PorSi3DLIB project is a public-private cooperation, also funded by the FNR, focusing on developing new Li-ion 3D batteries. Finally, the "ID and Data Collection for Sustainable Fuels" (IDACS) project, in which Luxembourg participates with 14 other Member States of the European Union, is another very important technological development project involving alternative fuels infrastructure.

The total budget of these four projects sums up to 2.404 million \in , with a portion of 1.299 million \in (54%) for the two projects financed by national sources.

5.1.5 Additional information on alternative fuels infrastructure developments

The Luxembourgish NIR indicates that official statistics on electricity use for private charging of electric vehicles will be available in 2020. It can also be expected that the project IDACS, carried out by Luxembourg in cooperation with additional 14 European Member States over the years 2019-2021, will deliver further information on alternative fuels infrastructure, including all fuels.

² <u>https://mobilab.lu/merlin/</u>

³ <u>https://ecobus.lu/</u>

5.1.6 Summary of the assessment

Tabular overview

Table 5.1.6-1 Overview of the NIR assessment

			Alternative fuel / transport mode								
		Indicators	Electricity / road	CNG / road	LNG / road	LNG / water (inland)	H2 / road	LPG / road			
		Past situation (2016)	1,118	294	1	NA	NA	361			
		Situation (2018)	3,373	314	13	1	NA	377			
		Estimate (2030)	202,600	100	150	1	NA	NA			
AF	Vehicles / Vessels	Future share (2030) [%]	34.36%	0.02%	0.65%						
		Estimate attainment (2018 vs 2030) [%]	nate attainment 18 vs 2030) [%] 1.66% 8.67% 100.00%								
		Progress (2018)	adequate	e 8.05%							
		Past situation (2016)	212	6	0	0	0	14			
		Situation (2018)	841	2	0	0	0	14			
Pu	ublicly accessible	Target (2030)	10,320	1	0	0	1	NA			
AF Infrastructure		Target attainment (2018 vs 2030) [%]	8.15%								
		Progress (2018)	adequate								
		2016	5.27	49.00				25.79			
		2018	4.01	157.00				26.93			
s	ufficiency Index	2020	6.40	90.00							
		2025	19.63	125.00							
		2030	19.63	100.00							
	Legal measures	Ambition (NIR vs NPF)	+	+			+				
	Policy measures	Score	Н	М			М				
	+	Comprehensiveness	С	N			N				
Measures	Deployment &	Impact	н	L			L				
	manufacturing support	Ambition (NIR vs NPF)	+	+			+				
	RTD&D	Ambition (NIR vs NPF)									

 Image: not applicable

 Legend:
 the value could not be computed

NA no value/information provided/available in the NIR

In its NIR, Luxembourg confirms and strengthens the NPF strategy to focus on electro-mobility for road transport. Concerning CNG, the LU NIR foresees only a marginal role and specifically for public transport (where the co-existence of BEV and PHEV buses and coaches will also be relevant). Regarding LNG, the LU NIR does not present a defined strategy. For hydrogen vehicles the same type of incentives of BEV vehicles are foreseen, but this AF is currently excluded from the Luxembourgish plans on AF. Finally, biofuels and LPG are and will continue to be marginal. The measures put in place by Luxembourg are coherent with this vision.

The main outcomes of the technical assessment of the Luxembourgish NIR on vehicles estimates and infrastructure targets can be summarised as follows:

Road transport

- Electricity In 2018 Luxembourg recorded 3,373 EVs and 841 publicly accessible recharging points. EVs included 8 HCVs and 55 buses and coaches. As for the next decade, the LU NIR presents a new plan with a much higher ambition compared to the NPF: for EVs, whilst the estimate is lower in 2020, it is more than compensated by the increase until 2030 (322% more), when 202,600 EVs are foreseen (of which 1,000 LVCs, 100 HCVs and 1,500 buses and coaches). The same situation is observed for the recharging infrastructure, where the LU NIR now targets a slightly lower (-7%) number of recharging points in 2020, but much higher numbers for the years 2025 (+163%) and 2030 (+375%). With reference to this new scenario, Luxembourg is progressing adequately both in terms of EV and infrastructure. However, the calculated Luxembourgish sufficiency index is becoming potentially inadequate for the years 2025 and 2030.
- **CNG** Luxembourg recorded a small number of 314 CNG vehicles in 2018, including 11 heavy-duty vehicles and 52 buses and coaches. The CNG fleet is expected to shrink to a total of 100 in 2030, with only the number of buses and coaches increasing slightly to 65. In line with the expected reduction in vehicles, the public infrastructure has been reduced, with two modernised refuelling stations remaining. This is considered sufficient by Luxembourg to cover current and future needs, and is confirmed by the adequate sufficiency index.
- **LNG** The Luxembourg fleet consisted in 2018 of 13 LNG heavy-duty vehicles. An increase to 150 vehicles by 2030 is estimated, but no public LNG refuelling point is planned until 2030. There was however one private LNG refuelling point in service, which should continue until 2030.
- **Hydrogen** At this moment hydrogen is not considered in the Luxembourgish fuel mix. There were no hydrogen vehicles/infrastructure registered in 2018 and no clear quantitative objectives provided for the future. However, the LU NIR declares that "*the government has committed, in its coalition agreement 2018-2023 (⁴), to arrange for at least one hydrogen refuelling station to be installed at one of the motorway service areas*" and this could take place by 2025.
- **Biofuels** In Luxembourg, 56 ethanol fuelled vehicles were registered in 2018. No information on future vehicles developments and on refuelling infrastructure was provided.
- LPG The LPG fleet of 377 vehicles registered in 2018 by Luxembourg included 8 heavyduty vehicles. No assessment on LPG can be made since no information on future development and infrastructure was provided.

Rail transport

• **Electricity** – Information is unavailable in the LU NIR.

Waterborne transport (inland)

• **Electricity** – The LU NIR reports one electric vessel in service since 2016. It also recorded 5 shore-side electricity supplies in 2018 and presents a target of 6 in 2020 and of 10 from 2025 to 2030.

⁴ <u>https://gouvernement.lu/dam-assets/documents/actualites/2018/12-decembre/Accord-de-coalition-2018-2023.pdf</u>, Coalition agreement 2018-2013, Luxembourg Government, December 2018.

• **LNG** – The LU NIR lists one LNG powered vessel in 2018 and for the next decade. Due to the large autonomy of LNG vessels, LNG refuelling infrastructure at the inland port Merter is not considered viable.

Air transport

• Electricity supply for stationary aircraft – The infrastructure to supply electricity for stationary aircraft at the Luxembourg airport is considered sufficient (44 units) and no increase is foreseen. The LU NIR mentions that 28 supply points consist in ground power units (diesel engines coupled to electricity generators) and no information is provided for the rest.

The Luxembourgish NIR presents an extended portfolio of **measures** compared to the NPF. However, the overall strategy remains the same, with almost total focus on the combination electricity/road (targeting both AFI and AFV), and only some generic reference to other AFs/transport modes. The Legal measures represent a step forward, and with higher ambition, to create a legally solid background to support the uptake of electro-mobility. The Policy and Deployment measures are coherently designed to realise these objectives. In terms of their expected impact to support the realisation of the AFV/AFI objectives as presented in the NPF and revised in the NIR, the measures for the pair electricity/road result to have a high impact, while those for the pairs CNG/road and hydrogen/road have a low impact. The RTD&D measures confirm and complete the overall strategy of Luxembourg to become "… one of the main players in electric mobility".

5.1.7 Final remarks

The Luxembourgish NIR provides a comprehensive report on efforts to implement the Directive. The NIR is in line with the provisions of Annex I to the Directive. All alternative fuels are addressed in the NIR. However, the focus is on electro-mobility, as confirmed also by the measures included in the NIR.

As regards electricity, the NIR estimates that there could be around 203,000 electric vehicles on the roads by 2030, representing about 34% of the future fleet by that time, as well as around 10,300 recharging points in the same year. Taking into account the current situation and expected trends, this level of ambition appears to be fully consistent with the pace of deployment of electric vehicles considered necessary for a full transition to carbon neutrality by 2050. No information on charging efficiency is provided. Five shore-side electricity supply facilities have been installed in Luxembourg's inland ports already. This number is noted to increase to 10 by 2025. Luxembourg's national airport has already installed 44 electricity supply points for stationary aircraft. Further information should be provided on the current and planned electrification of the rail network.

Regarding hydrogen for transport, the NIR estimates one hydrogen refuelling station planned for 2025. No information was provided on the number of future FCHVs. It would be relevant that Luxembourg provides more information on how to ensure EU-wide connectivity for this alternative fuel.

Concerning natural gas, there were 314 CNG vehicles in Luxemburg. A significant decrease in the existing CNG – mainly public fleet – is expected (100 CNG vehicles by 2030). The number of LNG vehicles is anticipated to increase from 13 in 2018 to 150 by 2030. However, the NIR does not provide any indication on the planned LNG refuelling points for road transport. The NIR reports one LNG-powered vessel. No targets are provided for LNG refuelling points in inland ports. In this respect, Luxembourg needs to provide more information in future reporting.

There was already a small fleet of 377 LPG vehicles in Luxembourg by 2018. The fact that no estimates are provided for the next decade indicates a lack of interest by Luxembourg in this vehicle's technology.

Further information should be provided on the consumption of biofuels for road and air transport. Luxembourg should provide more information in future reporting on efforts to promote the use of renewable fuels in transport, and particularly in aviation.

5.1.8 ANNEX - Description of the Member State

On a surface area of 2,600 km², Luxembourg has a population of 602,000 people in 2018, which makes up for a population density of 232 inhabitants/km².

Number of main urban agglomerations

• 1 urban agglomeration > 50,000 inhabitants

In 2018, Luxembourg achieves a per capita gross domestic product at market prices of \notin 98,640, which represents a per capita gross domestic product in purchasing power standards of 261 if expressed in relation to the EU-28 average set to equal 100.

Length of the road networks

The length of the road TEN-T Core Network in Luxembourg is 69 km. The total road network length is 2,889 km, of which 165 km are motorways.

The following lengths of the TEN-T Road Corridors are present in Luxembourg: 1% (32 km) of the North Sea - Mediterranean Corridor.

Through the TEN-T Road Corridors, Luxembourg is connected with the following Member States:

- Belgium (through the North Sea Mediterranean Corridor),
- France (through the North Sea Mediterranean Corridor)

Number of registered road vehicles

At the end of 2018, Luxembourg accounts for 492,481 registered road vehicles of which 415,145 are categorized as passenger cars, 34,833 as light goods vehicles, 10,161 as heavy goods vehicles and 2,042 as buses and coaches. The motorisation rate is 690 passenger cars per 1,000 inhabitants.

Number of ports in the TEN-T Core Network

- No maritime ports
- 1 inland port in the TEN-T Core Network (Luxembourg-Mertert)
- No inland ports in the TEN-T Comprehensive Network

Through the 37 km inland waterways TEN-T Core Network, Luxembourg is connected with Germany by the Rhine – Alpine and the North Sea – Mediterranean Corridor, and with France by the North Sea – Mediterranean Corridor.

Number of airports in the TEN-T Core Network

- 1 airport in the TEN-T Core Network (Luxembourg)
- No airports in the TEN-T Comprehensive Network